Calculating Energy Savings and Projected Emissions Reduced

A Case Study of Industrial Energy Efficiency Activities in Colombia

RESULTS AT A GLANCE

38,134 tCO_2e

mitigated from 2013 to 2024

estimated using CLEER tool for reporting on EG. 12-7 Projected GHGs

3,733 tCO_2e

mitigated in 2015

estimated using CLEER tool for reporting on EG. 12-6 Emissions Reduced

$195,640

estimated cost savings in 2015

404,145 GJ

of energy saved annually

64%

reduction in energy consumed by the Helados Tonny manufacturing plant

Access the Clean Energy Emission Reductions (CLEER) tool at cleertool.org.

This case study is one of a series being developed by the USAID Resources to Advance LEDS Implementation (RALI) project to demonstrate how to calculate USAID Global Climate Change (GCC) standard indicators for different types of clean energy activities. This case study calculates results achievable from energy efficiency interventions, including potential greenhouse gas (GHG) emission reductions through 2030, which can be reported under USAID GCC clean energy standard indicators. [1] *Note: USAID does substantial work supporting clean energy reforms that are not easily quantified but may have a greater impact than the activities described here. RALI seeks to develop cost-effective methodologies for assessing the impact of the full range of clean energy assistance provided by USAID.* [2]

PROMOTING CLEAN ENERGY IN COLOMBIA

USAID has worked with the government and people of Colombia for more than 50 years to improve social, economic, and environmental conditions. The Colombia Clean Energy Program (CCEP) is a five-year USAID program (2012–2017) that supports a whole-of-government low emission development program. One area of CCEP's work, is implementing activities that promote investment in energy efficiency technologies by providing training, outreach, efficiency audits, and analysis for intervention opportunities.

DEMONSTRATING SUCCESS IN ENERGY EFFICIENT MANUFACTURING

CCEP support for industrial energy efficiency interventions showcases successes in efficient manufacturing that are achieving significant results in energy and GHG savings. These interventions cover a range of industries, including the following:

Textiles: CCEP assistance has enabled three textile manufacturers—Crystal, CL WASH, and Puntoflex—to install efficient steam and thermal fluid boilers in their factories. These systems provide an average of 15% savings in fuel consumed relative to their existing coal boilers.

Chemicals: CCEP provided assistance to Amtex, a chemical company, to reduce turbulence inside a boiler, which increases efficiency. This intervention lowered annual natural gas consumption by approximately 36,000 cubic meters.

Food: CCEP performed an energy audit on an ice cream factory for Helados Tonny, which led to the installation of new efficient manufacturing and storage equipment, as well as an expansion in cold storage capacity. As a result of these interventions, the factory reduced energy consumption by 64%.

These efficiency upgrades in textile, chemical, and ice cream facilities are poised to yield significant energy and GHG emissions savings that can be replicated in other facilities. As these pilot interventions represent a fraction of CCEP activities, the program as a whole is expected to achieve substantially greater energy and GHG savings.

GHG ESTIMATION METHODOLOGY AND ASSUMPTIONS

The USAID RALI project used the Clean Energy Emission Reduction (CLEER) tool to quantify GHG benefits through 2024. The calculations, detailed below, align with USAID indicators EG.12-6 (annual GHG emissions reduced) and EG.12-7 (projected future GHG emission reductions). These activities can also report on EG.12-4 (investment mobilized).[5]

Helados Tonny ice cream refrigeration and manufacturing systems.

STEP 1 - RALI obtained project data from the CCEP team, which provided fuel and electricity savings for these activities**.**

STEP 2 - RALI estimated GHG emission reductions from fuel and electricity savings. The following equation was used to estimate emission reductions from fuel savings:

$$\text{Emissions Reduced } (\text{tCO}_2\text{e}) = \text{Fuel Savings (GJ)} \times \text{Emission Factor } \left(\frac{\text{tCO}_2\text{e}}{\text{GJ}}\right)$$

The GHG emission factor is the amount of carbon dioxide (CO_2) emitted per unit of energy. The emission factors used were 0.056 tCO_2e/GJ for natural gas and 0.095 tCO_2e/GJ for coal, both obtained from the Intergovernmental Panel on Climate Change (IPCC).[6]

The following equation was used to estimate emission reductions from electricity savings:

$$\text{Emissions Reduced } (\text{tCO}_2\text{e}) = \text{Electricity Savings (MWh)} \times \text{Emission Factor } \left(\frac{\text{tCO}_2\text{e}}{\text{MWh}}\right) \times \frac{1}{(1 - \text{Line Loss Factor})}(\%)$$

The grid electricity emission factor utilized is a national-level combined marginal emission factor. This factor is a national average of all combined marginal emission factors used by registered Clean Development Mechanism (CDM) projects (2004-2015), which are based on the CDM methodology.[7] The line loss factor accounts for additional energy needed to be produced in order to deliver the required amount of electricity. The line loss factor used was derived from International Energy Agency (IEA) data, and adjusted to remove non-technical line loss such as theft of electricity.[8] For investments that both increase the productivity of the facility and increase efficiency, RALI calculated the electricity savings relative to a baseline scenario that assumed expanding the capacity without energy efficient practices.

What is a combined marginal emission factor?

A *combined marginal emission factor* takes into account both operating margin and build margin. Operating margin reflects avoided emissions from existing power infrastructure (i.e., power plants or sources that already supply electricity to the country's electric grid). Build margin reflects avoided emissions from new infrastructure (i.e., new power plants or sources that would need to be built to meet additional electricity needs).

CLEER uses combined marginal emission factors to better reflect the emissions likely to be reduced or avoided as a result of clean energy interventions.

In order to estimate projected cumulative GHG emissions avoided for each year from these interventions, RALI used a project lifetime of 10 years provided by CCEP. Based on this assumption, impacts would cease in 2024, 10 years after the interventions are completed. RALI assumed a technology degradation rate of 0.5% per year (based on RALI expert judgement).

COST SAVINGS METHODOLOGY AND RESULTS

The USAID RALI project estimated cost savings associated with energy efficiency interventions. The following equation was used to estimate cost savings from electricity savings:

$$\text{Cost Savings } (\$) = \text{Electricity Savings (MWh)} \times \text{Electricity Price } \left(\frac{\text{COP}}{\text{MWh}}\right) \times \text{Exchange Rate } \left(\frac{\$}{\text{COP}}\right)$$

Electricity savings (MWh) is the amount of electricity saved as a result of the energy efficiency intervention. The electricity price used was the per unit-price of electricity for industries in Colombia for 2015, obtained from the Asociación Colombiana de Generadores de Energía Eléctrica (ALCOGEN).[9] The exchange rate of Colombian Pesos (COP) to U.S. dollars was obtained from the United States Treasury, and reflects the 2015 market rate.[10]

The following equation was used to estimate cost savings from fuel savings:

$$\text{Cost Savings } (\$) = \text{Fuel Savings (GJ)} \times \text{Fuel Price } \left(\frac{\text{COP}}{\text{GJ}}\right) \times \text{Exchange Rate } \left(\frac{\$}{\text{COP}}\right)$$

The natural gas and coal prices used were the flat rate in 2015 obtained from Gas Natural Fenosa and the World Bank, respectively.[11,12]

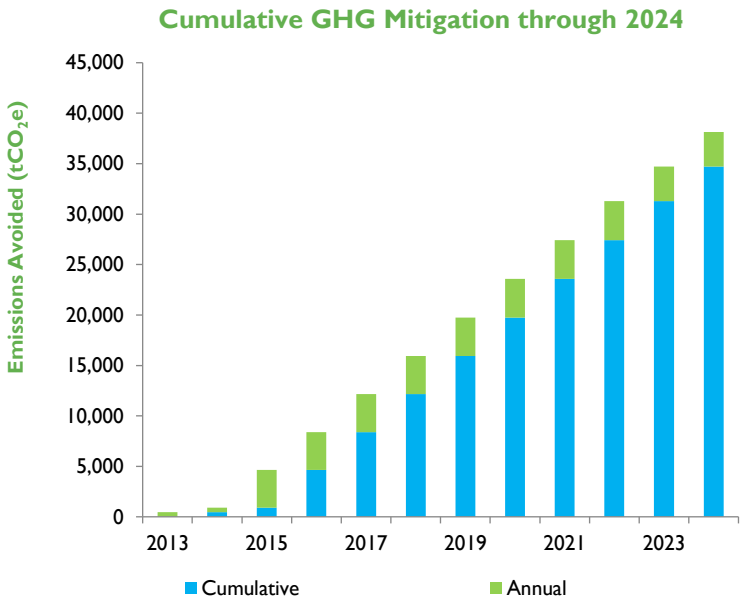
GHG CALCULATIONS AND RESULTS

RALI estimates that in 2015, 3,733 metric tons of CO_2-equivalent (tCO_2e) was reduced from the implementation of these energy efficiency interventions.

From 2013-2024, these energy efficiency interventions are expected to result in a total reduction of 38,134 tCO_2e (i.e., 32,740 tCO_2e from textile manufacturing, 4,606 tCO_2e from food production, and 788 tCO_2e from chemical manufacturing), equivalent to the annual emissions from energy use in over 4,000 U.S. homes.[13]

These pilot interventions are expected save 404,145 GJ of energy annually. Energy and GHG savings of these magnitudes could likely be achieved in similar facilities in Colombia.

Years	GHG Savings (tCO_2e)
2013-2020	23,582
2021-2025	14,552
Total	**38,134**



COST SAVINGS

Energy efficiency investments that displaced electricity are estimated to have saved $113,680 in 2015. Additionally, energy efficiency investments that displaced natural gas and coal consumption are estimated to have saved $13,450 and $68,510 in 2015, respectively. In total, these interventions are estimated to have saved $195,640 in 2015. Similar cost savings are expected to continue to occur each year over the lifetime of the equipment, subject to changes in the market price of electricity, natural gas, and coal.

FOOTNOTES AND REFERENCES

[1] USAID (2016). GCC Standard Indicator Handbook. <https://www.climatelinks.org/resources/gcc-standard-indicator-handbook>

[2] USAID (2016). GCC Clean Energy. <https://www.usaid.gov/climate/clean-energy>

[3] USAID (2016). USAID Colombia History. <https://www.usaid.gov/colombia/history>

[4] USAID (2016). Colombia Clean Energy Program. <http://www.ccep.co/en/what-is-ccep/colombia-clean-energy-program>

[5] Investment mobilized measures capital invested by the private company partners on EE equipment as a result of the project.

[6] IPCC (2006). IPCC Guidelines for National Greenhouse Gas Inventories. <http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_2_Ch2_Stationary_Combustion.pdf>

[7] Institute for Global Environmental Strategies (2015). List of Grid Emission Factors – Version 2015/10. <http://pub.iges.or.jp/modules/envirolib/view.php?docid=2136>

[8] IEA (2013). World Electricity and Heat Supply and Consumption. <https://www.iea.org/statistics/relateddatabases/electricityinformation/>

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[10] US Treasury (2017). Treasury Reporting Rates of Exchange. <https://www.fiscal.treasury.gov/fsreports/rpt/treasRptRateExch/itin-12-31-2015.pdf>

[11] Gas Natural Fenosa (2017). Tarifas. <http://www.gasnaturalfenosa.com.co/co/grandes+clientes/distribucion/1297102581680/tarifas.html>

[12] World Bank (2017). Global Economic Monitor Commodities. <http://databank.worldbank.org/data/reports.aspx?source=global-economic-monitor-(gem)-commodities>

[13] U.S. Environmental Protection Agency (2017). Greenhouse Gas Equivalencies Calculator. <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>

Contact

USAID Colombia
Emily Waytoti
Deputy Director
ewaytoti@usaid.gov

USAID
Jennifer Leisch
Climate Change Specialist
jleisch@usaid.gov

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